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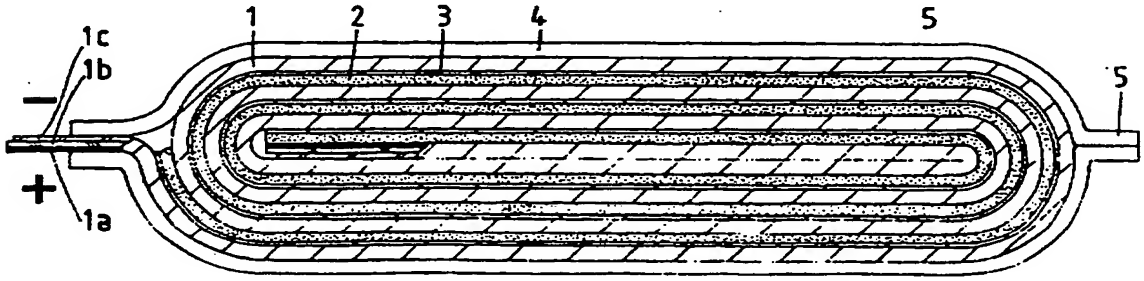
(54) Abstract Title
Sealed duplex electrode electrochemical cell

(57) A novel construction for an electrochemical cell is described in which metal layers or films, too thin to be self supporting are formed on either side of a thin flexible polymer film 1b with the active materials which store electrochemical energy being disposed and bonded on to the metal layers. The metal coated polymer sandwich referred to as a duplex electrode is fed through an insulative laminate container 4 to which it is heat sealed thus giving a single piece bi-terminal. The other components of the cell are a microporous separator and liquid electrolyte or a polymer electrolyte which is inherently ion conductive.

FIGURE 1



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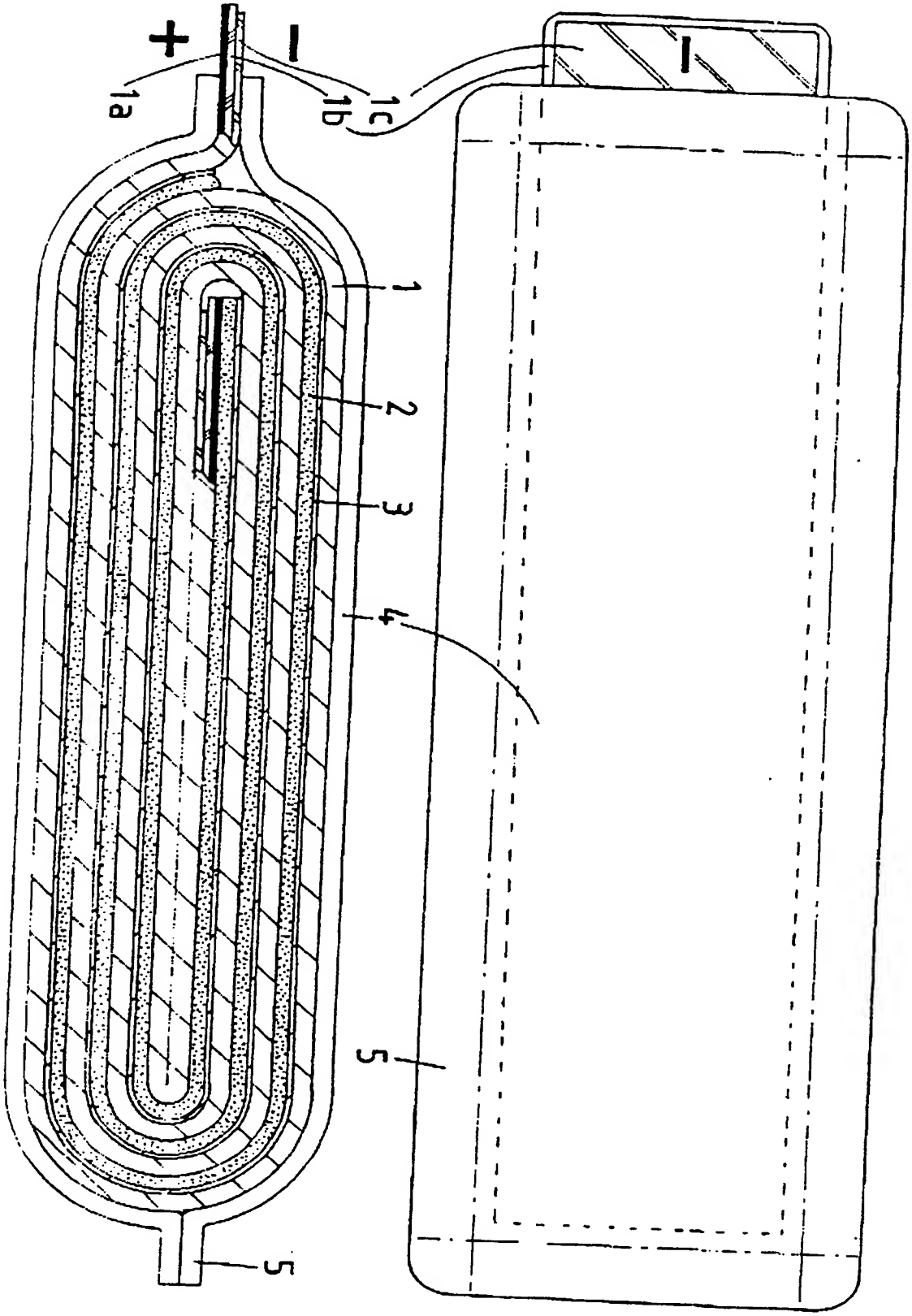

FIGURE 1

FIGURE 2

DRAWING NOT TO SCALE

Sealed Duplex Electrode Electrochemical Cell

This invention concerns an efficient and cost-effective means for the construction and sealing of an electrochemical cell, particularly a non-aqueous lithium cell having high surface area electrodes.

There are several lithium rechargeable cell systems now on the market e.g. Lithium ion from Sony Energytec, in which the positive electrode or cathode is a metal oxide or mixture of metal oxides formed as a thin layer on an aluminium foil and an anode or negative electrode which has a layer of carbon or graphite dispersed in a polymer binder coated on to a copper foil current collector. Single layer cells are readily constructed with such active electrodes and spiral winding is used to construct cylindrical cells. In such designs, the volume ratio of current collector to active material tends to be high unless double sided coating of both electrodes is adopted. The latter presents certain production difficulties, in particular, the gross thickness of the cathode makes it difficult to bend the electrodes around small radii as is required in a wound cell.

The present invention provides a means for the production of thin duplex electrodes which can be bent through 180° without shedding the cathode material. A cost effective means of cell assembly for large units is described and the terminations from the internal electrode pack to the outside of the cell may be brought through as an integrated bi-terminal, obviating the need for any metal toi metal joining. One embodiment of the invention may include a one piece duplex electrode which can be bonded to the internal sides of a container bag by heat sealing.

An embodiment of the invention is best illustrated by reference to Figure 1. A flexible laminate (1), is shown and consists typically of aluminium foil about 9 microns thick (1a), polyester about 8 microns thick (1b) and a conductive layer of copper and/or graphite (1c). The conductive layer is coated on one side of the polyester leaving a margin of 2 to 3 mm from both side and end edges in order to avoid short circuits with the aluminium layer. The thickness of the copper layer is typically 5 microns.

The cathode material (2) is coated on to the aluminium side to give a typical thickness of 150 microns after drying. The duplex electrode thus formed is now folded with a microporous separator (3) such as Celgard 2500 from

Hoeeechst Celanese by bending through 180°, the conductive copper layer being on the inside. This is the preferred configuration since the cathode is always bent convexly and is thus less liable to crumble. Folding up to form a thick section is facilitated since the bending radius increases with each turn. Electrolyte can be applied either as the folds are beinf made or by vacuum impregnation after the folded pack is completed.

The final step is the placement of the electrode pack in a container which may consist of a laminate bag (4) with the full width of the duplex electrode led out as shown in Figure 2. Cathode material must be removed from the aluminium layer where the seal is to be made. The bag laminate is typically a barrier type material such as is widely used in the food industry, aluminium foil forming the moisture barrier and a polyolefin type of film as a sealant. The container bag is heat sealed around the edges (5) and completely envelops and bonds to both the aluminium and copper layers.

CLAIMS

1. An electrochemical cell in which the conductive current collector layers are formed on to opposing sides of a thin flexible polymer film which exits through and is hermetically sealed to the container, the battery active materials being coalesced on to the exposed current collector surfaces,

2. A cell according to Claim 1, in which the conductive layers bonded to the polymer film exit to form a combined flat terminal having opposing positive and negative faces.

3. A cell according to Claim 1, in which the current collectors may be metallic, non-metallic, composites of carbon or conductive polymer materials.

4. A cell according to Claim 1, in which the current collectors are copper and aluminium respectively, the active material on the latter being a rechargeable lithium positive electrode.

5. A cell in which the insulating polymer film may consist of a polyimide, a polyester or polyolefin which resists attack by the electrolyte chosen to transfer charge between the active electrodes.

6. A cell in which the electrode structure may be spirally wound to give a cylindrical form or folded flat to give a rectangular configuration.

7. A cell according to claim 6 in which the outward facing positive and negative electrodes are separated by either a microporous polymer layer and liquid electrolyte or a polymeric lithium ion conductive solid electrolyte.

8. A cell as described in any of the preceding claims which is hermetically contained in either a flexible or a rigid enclosure.

The Patent Office

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Claims searched: Claims 1-4 and 8

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Other: On line databases WPI,EDOC,JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB2251118A	Hope see claim 1	Claim 1 at least
Y	US5360684A	Duval see example 1	"
X,Y	EP0499005A	Duval see Fig 1	"

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.